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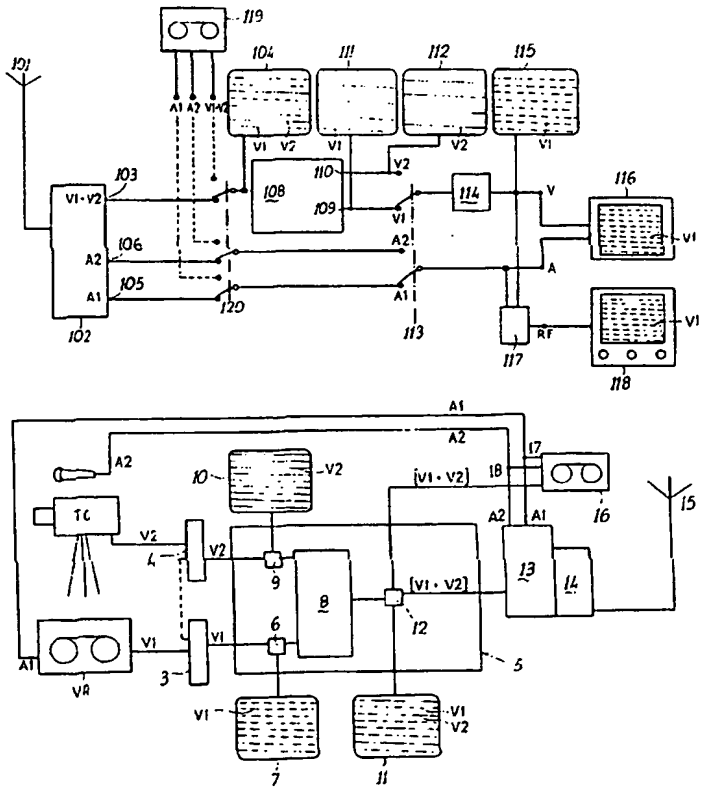
(57) Abstract

Subject-matter of this invention is a system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs, wherein, in a transmission/recording operation, the two video signals (V1, V2) of the two different programs are composed by means of a composer device (8; SW) into a single composite video resulting signal [V1 + V2] which includes a field (odd or even rows) of the first signal (V1) and a field (even or odd rows) of the second signal (V2) and, in a reception/reproduction operation, each frame of said video resultant signal [V1 + V2] is decomposed by means of a decomposer device (108; M1, M2) into its component fields (odd and even rows), respectively pertaining the one to said first video signal (V1) and the second to said second video signal (V2), said signals being adapted to be separately utilised after having been passed through a duplicator device (114; A/D-MEM-D/A) which adds to each field obtained by means of said decomposition step an identical field obtained by duplication thereof, in order to re-establish a whole frame.



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A SYSTEM FOR COMPOSITION/DECOMPOSITION OF VIDEO SIGNALS TO ENABLE TO TRANSMIT/RECEIVE AND TO RECORD/PLAYBACK CONTEMPORANEOUSLY TWO TV PROGRAMS.

This invention relates in broad terms to systems for composition and decomposition of video signals and more particularly relates to a system adapted to compose two video signals into a single resultant video signal, in order to enable their contemporaneous transmission or video recording by means of a single transmitter or a single video recorder, respectively, and subsequently to decompose said resultant video signal into its two component video signals in order to enable their discrete and independent utilization.

As it is known, when the contemporaneous transmission of two television programs is desired, two broadcasting stations are obviously needed, each provided with its own high and low frequency equipment and each operating upon its own television channel.

As it is also known, the use of video recorders is becoming even more popular, with consequent increase in use of video cassettes, both in professional field and in amateur field.

Analogously, therefore, when it is desired to contemporaneously record two different television programs, two distinct video recorders and two different video cassettes are needed.

In view of the above, both from a transmission and from a video recording standpoint, if the two video signals representing the two television programs are "composed" into a single "resultant" video signal by means of a suitable device, a single broadcasting station would be sufficient to transmit them upon a single TV channel, or a single video recorder would be sufficient to record them upon a single video cassette.

When the resultant video signal is to be received or reproduced (played back), a particular device symmetrically operating with respect to the previous one could provide for decomposing it into its two component video signals, thereby enabling to receive the two component video signals and to seiect between the two broadcast programs the preferred one.

When a system like this is exploited, two television broadcasting stations could contemporaneously use the same TV channel, or each broadcasting station could broadcast two different programs by using a single TV channel, thereby offering a solution to the

problem of restricted number thereof. In addition, a single video recorder would be sufficient to contemporaneously record two different television programs upon a single cassette, thereby offering a noticeable reduction in time, cost and room requirements, since the number of video cassettes to be stored would be reduced to half. Referring then to the transmission of tridimensional programs, a system according to this invention would enable to broadcast tridimensional programs by using a single channel, rather than two channels, as it presently occurs in some implementations.

At the present state of the art, many workers are studying such a possibility, but the solutions they propose are based upon new video standards or upon an increase of the band width of the TV channels or, anyhow, upon use of sophisticated equipment in substitution for existing TV sets.

In a first aspect, therefore, it is an object of this invention to provide a system for composing two component video signals into a single resultant video signal, in order to enable the broadcasting of two different programs upon a single TV channel, and for subsequently decomposing it into its two component video signals, in order to enable their individual independent utilization, without modifying the presently available low and high frequency equipment and the presently used band width of the television channels.

In a second aspect, it is an object of this invention to provide a system for composing two component video signals into a single resultant video signal, in order to enable two different television programs to be contemporaneously recorded, combined or overlapped, upon a single video cassette, regardless of the quality of the tape to be used and of the drive speed of the video recorder, and for decomposing the played back or reproduced video signal into its two component video signals, in order to enable the two recorded programs to be separately and independently played back.

The system of this invention, both in its first and in its second aspects, is based upon two essential stages or steps:

A) COMPOSITION. By using a unique "composer" device, two different video signals, V1 and V2, are composed into a single "resultant" video signal [V1+V2]. This resultant video signal [V1+V2], even if it has all characteristics and parameters of a conventional video frequency signal, it has the unique characteristic feature that it contains, in its field related

to the even rows, the field of the even rows of the first component video signal V1 and, in its field related to the odd rows, the field of the odd rows of the second component video signal V2. The two signals (and the related TV programs) V1 and V2 are combined or overlapped or, with a more correct terminology, are alternatively interlaced field by field.

A conventional transmitter and a single TV channel are sufficient for broadcasting said resultant video signal [V1+V2]. Analogously, a single video recorder is sufficient for recording the same signal upon a single video cassette.

Of course, according to the system of this invention, the two different video signals related to two different television programs should be perfectly synchronised by a single synchronisation generator for enabling their "composition". In the most usual circumstance, the two signals generated by different sources (satellite, video recorder, TV camera, video disk, and so on) are not synchronised. This means that a preliminary step is to provide for their synchronisation by means of two TBC (Time Base Corrector) circuits locked with each other.

B) DECOMPOSITION. In order, to make its utilisation possible, upon being received (or played back), the resulting video signal [V1+V2] should be "decomposed" into its two component video signals V1 and V2 by means of a "decomposer" device, to enable a TV viewer to select the program he or she prefers between the two programs V1 and V2, even if he or she has the TV set tuned upon a single TV channel. In other words, the decomposer or decombiner device performs the function to separate the fields of the first component signal V1 from the fields of the second component signal V2 and, since said fields, upon being separated, are all odd for one of the component signals and all even for the other component signal, the concerned decomposer device should also provide for adding to each of said component signals the lacking fields.

Further details and advantages of this invention will be apparent from the following description by referring to the annexed drawing wherein the preferred embodiments are shown by way of illustration and not by way of limitation.

In the drawings:

Figure 1 shows a diagram of the system according to this invention in its transmission or broadcasting arrangement;

Figure 2 shows a decomposer apparatus to be used in combination with a TV set;

Figure 3 shows a diagram of the decomposer apparatus according to Figure 2 of this invention;

Figure 4 shows the shape of the two signals to be composed/decomposed according to this invention;

Figure 5 shows a block diagram of the composer or interlacer unit;

Figure 6 shows the manner in which the two component signals are composed to obtain the resulting signal;

Figure 7 shows a block diagram of the decomposer unit;

Figure 8 shows a composer apparatus according to this invention for use in video recording situation;

Figure 9 shows a decomposer apparatus according to this invention for use in video recording situation;

Figure 10 shows a circuit implementation of the composer apparatus of Figure 8;

Figure 11 shows a circuit implementation of the decomposer apparatus of Figure 9.

Before giving a detailed description of the circuits and of the operation, it is believed convenient to set forth some remarks.

First of all, integrated circuits of "Matrix Switch" type (or multi-input multi-output switching circuits) are commercially available, for instance TEA 6415B and like. Such circuits, when they are suitably driven by a microprocessor or by other similar integrated circuits, are adapted to carry out a high number of predetermined switching operations. They substantially comprise two parallel amplification functions together with a switching function. Such circuits are generally known as "inserter", "interlacer" or "diplexer" circuits.

Furthermore, digital memories of FIFO (First-In-First-Out) type are commercially available. Such memories are adapted to continuously store information at very high speed, while contemporaneously they "discharge" or "issue" the previously stored information. As it is well known, these memories are driven by control logic circuits, which can also be programmed.

By referring to Figure 1, the principle diagram is shown of a station for broadcasting two different television programs represented by signals V1 and V2 based upon the concepts of this invention.

The two heterogeneous video signals V1 and V2 are generated for instance by a video recorder VR and by a TV camera TC and are applied respectively to two time base corrector (TBC) circuits 3 and 4, which are synchronised with one another in order that the two output signals V1 and V2 be also respectively synchronised with one another and in-phase.

The two signals V1 and V2 are applied to a "composer" block 5, the details of which will be apparent in the subsequent description; in particular, the video signals V1 and V2 are applied to video distributor units 6 and 9, the first two outputs of which are connected to the two inputs of a composer unit 8 of the above mentioned Matrix Switch or interlacer type.

The derivations of the video distributor devices 6 and 9, namely their second outputs, are respectively connected to a monitor 7 and to a monitor 10.

The composer or interlacer unit 8 performs the functions to process signals V1 and V2, to extract the synchronisation components and the modulation therefrom and to compose them into a "resultant" video signal [V1+V2], synchronised with the two component signals V1 and V2, and characterised in that its field related to the even rows comprises the field related to the even rows of the first component signal V1 (dashed lines in Figure 1) and its field related to the odd rows comprises the field related to the odd rows of the second component signal V2 (solid lines in Figure 1).

The composer or interlacer unit 8 will be detailedly explained herein below. At present and by referring to Figure 1, it can be observed that the resultant video signal [V1+V2] output by the composer unit 8 is applied to a video distributor device 12 (a simple device having one input and three outputs), the three outputs of which are connected to a monitor 11, to a modulator block 13 and to a video recorder 16, respectively.

When it is observed upon monitor 11, the resultant video signal [V1+V2] includes in its even rows (shown as dashed lines) the corresponding field of the first component video signal V1 and, in its odd rows (shown as solid lines), the corresponding field of the second

component video signal V2. In order to make the drawing more comprehensible, only eight rather than 625 rows have been shown, so as to evidence the field alternance.

The second output of the video distributor device 12 applies the resulting video signal [V1+V2] to modulator 13 of transmitter 14 for its broadcasting by means of antenna 15. In this way, the two signals V1 and V2 are interlaced into a single composite signal [V1+V2] and are contemporaneously broadcast upon a single TV channel.

Of course, the two TV programs V1 and V2 have their own audio contents A1 and A2. These audio signals are directly connected to said modulator 13, which is conveniently of stereophonic bilingual type and has two audio inputs that are coded according to known stereophonic parameters and broadcast by the same transmitter 14.

The resulting signal [V1+V2], as above mentioned, is also adapted to be recorded upon a video cassette by means of a video recorder 16, which receives the resulting signal [V1+V2] from a third output of the video distributor 12. The video recorder should be adapted to contemporaneously record upon two tracks the audio signals A1 and A2 related to the two programs V1 and V2, said audio signals A1 and A2 being picked up by mean of two audio derivators or distributors 17 and 18. In this way, the two video signals V1 and V2 interlaced in a single composite signal [V1+V2] and the two audio signals A1 and A2 are contemporaneously recorded by means of a single video recorder and upon a single video cassette.

In a reception situation, it is necessary to use a "decomposer" device to separate the two different programs V1 and V2. Such a device is contained in an independent casing such as shown in Figure 2, which is inserted between the antenna socket and a traditional TV set or a TV set provided with an AV socket. In Figure 2, it is possible to observe the antenna input 1 and the outputs A and V to be connected to a monitor or to a TV set provided with an AV socket. A RF output 5 is also shown for direct connection to an antenna input of a conventional TV set. Also shown are the low frequency inputs A1 (audio 1) and A2 (audio 2) as well as [V1 + V2] for the composite video signal, should it be desired to decompose the signal [V1 + V2] output from a video recorder. Switch 6 enables to select input RF or VF and switch 7 enables to select the preferred one between the two decomposed or separated programs.

By referring now to Figure 3, it can be observed that the decomposer apparatus comprises three essential stages: a "tuner" module or unit designed for tuning on the channel it is desired to receive and for low frequency demodulating it; a "decomposer" module or unit, designed for decomposing the "resultant" video signal [V1+V2] into its two component signals V1 and V2; a row "duplicator" module or unit designed for integrating the fields of signal V1 or of signal V2 in order to re-establish a whole frame (625 rows). These units can be individually recognised in Figure 3 and will be detailedly described in so far as they are part of this invention.

By referring to Figure 3, the "resultant" or composite signal [V1+V2], upon being broadcast upon a certain TV channel, is received through antenna 101 and is applied to tuner-demodulator unit 102. When said tuner unit 102 is tuned on the same channel, the "resultant" composite video signal [V1+V2] is available from output 103 and is applied to "decomposer" unit 108, said composite video signal being observable upon monitor 104, even if it is visually unintelligible. Decomposer unit 108 decomposes the concerned resultant video signal [V1+V2] into its two component video signals V1 and V2 and furnishes them separately from outputs 109 and 110.

The field related to the even rows (dashed lines) of the first component signal V1 can be observed upon monitor 111 which is connected to output 109, while the field related to the add rows (solid lines) of the second component signal V2 can be observed upon monitor 112 which is connected to output 110. The images appearing on monitors 111 and 112 are intelligible, but they include only 312.5 odd rows or 312.5 even rows and, therefore, they are "flickering" and not well defined in vertical sense. This drawback will be eliminated by said duplicator unit.

The two component video signals V1 and V2 are connected to terminals of a switch 113. This switch is a two-way switch, one for switching video signals (V1 and V2) and the other for switching audio signals (A1 and A2).

Audio signals A1 and A2 associated to video programs V1 and V2 are furnished by said tuner-demodulator unit 102 through outputs 105 and 106. Tuner-demodulator unit 102 can also be associated with a stereo-decoder and, therefore, it can furnish two separate outputs.

In Figure 3, switch 113 is in position A1-V1 and, therefore, video signal V1 and audio signal A1 associated thereto will be available at the output of the switch (of course, when switch 113 is in the other position, signals A2 and V2 will be available at its output).

The third above mentioned unit is a duplicator unit 114. It is an electronic device which carries out a duplication of each field, even or odd rows, and the insertion thereof for the lacking field: in this way, the output signal will be more stable and defined. In fact, it comprises both fields, even if the added field is a duplication of the first one; this occurs in like manner when a "high definition" image is "simulated" by duplicating the 625 rows of a conventional frame in order to obtain a frame of 1250 rows.

The previously mentioned four rows related to component signal V1 displayed upon monitor 111 have been duplicated upon monitor 115 so as to obtain eight rows, in order to show that the 315.5 rows of a conventional field are to be duplicated in order to obtain a conventional frame of 625 rows.

In addition, audio and video signals are applied to outputs A and V which can be connected to a monitor (or TV set provided with AV input socket) 116. The same outputs conveniently picked up are applied to modulator 117 adjusted upon a predetermined TV channel and the output of said modulator can be directly connected to a conventional TV set 118 which will tuned on the modulator channel.

By operating switch 113, program V1/A1 or program V2/A2 can be selected.

The input signal [V1+V2] for decomposer unit 108 as well as the two audio signals A1 and A2 can be furnished either by said tuned-demodulator 102 or by a video recorder 119 which plays back or reproduces signal [V1+V2] from a video cassette, whereupon said signal [V1+V2] is recorded by a system according to this invention, together with the above mentioned audio signals A1 and A2.

A three-way switch 120 provides for effecting such a selection.

When decomposer device has been discussed, it has been illustrated as an eternal device to be inserted between the antenna and a TV set and as such it has been shown in the drawing: it should be understood, however, that it can be implemented as a card to be incorporated into the TV set or, as far as newly manufactured TV sets are

concerned, it can be directly built in therein thereby enhancing the possibilities and the performances of the TV set itself.

As concerns the circuit implementation of the composer unit 8 of Figure 1, reference is now made to Figures 4 and 5. In Figure 6, the patterns of two video signals V1 and V2 consisting of EVEN fields and of ODD fields are shown, while Figure 5 shows the related block diagrams.

The two signals V1 and V2 are applied to two amplifications paths, designated as odd amplifier and even amplifier. For instance, operational circuits of TEA 2014 or like type can be used, since they can provide for a band width of more than 6 MHz with a gain of 6 dB, and have an input clamp circuit, which is necessary to clamp the black level of both input signals to the same potential value. A balancing potentiometer P inserted between the two input terminals provides for compensating any small differences possibly existing between the two input signals.

Upon being stabilised, balanced and amplified, the signals are directly applied to a switching circuit CC, for instance of the TEA 5114 type. Furthermore, one of the two above said signals, for instance signal V2 coming from even amplifier, is applied to a sync separation or extraction block SS, for instance implemented by means of a LM 1881 type circuit, which is followed by a sync amplifier and furnishes the well known Gen-Lock signals to the generator of signals V1, since, as above mentioned and as it is well known to those skilled in the art, signals V1 and V2 should be perfectly synchronised with one another.

In addition to this information, the sync separation block SS also supplies a two state ODD-EVEN signal which changes its state at each field. This signal is applied to switching circuit CC and drives it so as to let signals V1 and V2 pass alternatively. Since the commutation occurs at a frequency identical to the field or half-frame frequency, the result is easily understandable: we shall obtain at the input of the final amplifier AF a television composite or resultant signal [V1+V2] consisting of the only odd fields of the first component signal V1 alternated with the only even fields of the second component signal V2.

A graphic representation of this operation is shown in Figure 6 and needs no further explanations.

The final amplifier AF suitably adjusts the amplitude of the resulting signal [V1+V2] and, upon matching to 75 ohm, a standard video

signal is obtained, ready for utilisation in television broadcasting or recording.

The decomposition of the resultant signal |V1+V2| is carried out in decomposer unit 108 of Figure 3, a schematic implementation of which is shown in Figure 7.

By referring to Figure 7, it can be observed that the resulting signal |V1+V2| brought to standard level by means of a resistor of 75 ohm connected to ground is passed through a condenser C, is amplified in amplifier circuit AMP, for instance of the TEA 2014 type (pass band 6 MHz, gain +6 dB) and is applied to a sync separator unit SS and to a switching circuit CC. The sync separator unit SS generates a signal strictly corresponding to the ODD-EVEN signal of Figure 6 and so it drives said switching or commutation circuit CC which operates symmetrically to switching or commutation circuit CC of Figures 5 and 6, so that a signal V1 containing all odd fields and a signal V2 containing all even fields of composite signal |V1+V2| will be respectively available at its outputs. Such signals are amplified by means of respective amplifiers AMPV1 and AMPV2, but they appear as anomalous signals, because each of them includes one only field type, odd on even, respectively, the fields of the other type being lacking or "black".

Anyhow, the fields of the signals V1 and V2 are identical to the starting fields, because they have not been subjected to any digital process.

The insertion of the lacking fields is carried out by means of a suitable field digital memory which duplicates each field and inserts it in substitution for the lacking one.

It should be noted that, in stead of a field memory, further details of which will be subsequently given, a unique delay line can be used, having a delay of 20 milliseconds (1/50 second), by means of which it is possible to duplicate at 20 millisecond intervals the previous row: in this way, each row of the present field is duplicated exactly after 1/50 second, and the lacking field is thereby filled up row by row.

By means of a system as heretofore illustrated, it is also possible to exploit the rows of a field for broadcasting a television program and the rows of the other field for transmitting information of various kinds, for instance information extracted from a data bank.

Even if those skilled in the art are perfectly capable to adapt all up to now set forth teachings related to video transmission also to video recording, this second aspect of the invention will now be illustrated by referring to Figures 8-11, being it understood that any repeated description will have only the function to make more clear the concepts that are identical in both aspects.

Referring to Figure 8, it can be observed that two inputs A1-V1 and A2-V2 are provided for application of two different video signals V1 and V2 with audio signals A1 and A2, respectively, associated thereto. The television radio frequency signals coming from an antenna are applied to an input socket RF. Commutator 202 enables to select inputs RF/AV.

When it is desired to video record two broadcast programs, it will be necessary to conventionally tune the apparatus individually on said two different programs, by means of two tuner units 11 and 12. This operations can also be carried out by means of a remote control.

When it is desired to carry out the recording in base band, the two concerned signals are applied to the respective inputs.

In the output section, the outputs [V1+V2] (namely the video composite or interlaced signal), A1 and A2 (namely the two audio signals associated to the two programs) are connected to inputs designated Video, Audio 1 and Audio 2 of the video recorder. The recording operation is conventionally carried out, since in effect said "interlaced" signal is not different with respect to a conventional video signal.

A possible electronic diagram of the interlacer or composer device of Figure 8 is shown in Figure 10, wherein, for the sake of simplicity, the various interconnection components between the stages have not been shown, because they are perfectly known to those skilled in the art and can be employed according to conventional techniques.

Input signals V1 and V2 (which, of course, should be synchronised, for instance by means of a synchroniser, that can be a separate unit or can be arranged within the interlacer module of Figure 8) are firstly balanced by means of a potentiometer B and are then applied to the two inputs of a specialised integrated circuit SW of the above mentioned type, comprising two parallel amplifier functions with a switch function, for instance of TEA 2014 on like type. Two video amplifiers of

good quality, with a 6 MHz pass band and an amplification factor of 6 dB are included in the first section of this integrated circuit.

One of the two input signals V1, V2 (in this case signal V2 has been selected) is applied to a sync separator circuit SS1, before being entered into circuit SW. Also the latter circuit SS1 is a commercially available circuit, for instance of the LM 1881 or like type.

Said sync separator circuit SS1 also furnishes a two state signal which changes its state at each field, whereby it can also be designated as ODD-EVEN signal and is adapted, therefore, to drive the switch function of integrated circuit SW. In this way, said integrated circuit SW is enabled to let only the odd fields (ODD) of the first input signal V1 or only the even fields (EVEN) of the second input signal V2 pass.

At the output of circuit SW a unique "composite" or "interlaced" signal [V1+V2] is obtained, each frame of which is comprised of an odd field of the first input component signal V1 and of an even field of the second input component signal V2.

The thereby obtained interlaced signal is applied to an amplification stage SA which furnished an output 75-ohm standardised video signal that can be applied to a video recorder or anyway utilised as a conventional video signal, even if it has a scarce practical utility, in view of its insignificant "visually intelligible" contents.

If desired, a three-way switch CU can be inserted after the above mentioned amplifier stage SA: by operation of switch CU, it will be possible to select signal V1 or signal V2 (both picked up at the input terminals of the circuit) or interlaced signal [V1+V2]. It is to be noted that switch CU can also be automatic, so that, should one of the two input signals V1 or V2 be lacking, it automatically lets the other signal pass.

The audio input signals are directly connected to the related outputs.

By referring now to the decomposer or de-interlacer device of Figure 9, the interlaced signal which it is desired to decompose or de-interlace in order to retrieve its two component signals is applied to the input socket designated "V1+V2" and its two related audio signals are applied to the input sockets designated "A1" and "A2".

The two output signals V1 and V2 (with the audio output signals A1 and A2 associated thereto) can be contemporaneously and independently utilised upon monitors or TV sets; they can also be

projected by means of two independent video projectors. Furthermore, should the starting signal [V1 + V2] be a video tridimensional signal, these component video signals would enable a three dimension projection to be effected.

Should one only monitor or TV set be available, switch 203 enables one of the two programs to be selected. In this situation, outputs V and A are to be connected to the video and audio inputs of the monitor or TV set, in order to view the selected program.

A possible electronic circuit diagram of the decomposer o de-interlacer device of Figure 9 is shown in Figure 11 wherein, also for the sake of simplicity, the interconnection components between the various stages have been omitted, because they are perfectly known to those skilled in the art and are employed according to standard conventional techniques.

By referring to Figure 11, it can be observed that signal [V1 + V2] is applied to a first stage M1 of a matrix circuit (of the above mentioned Matrix Switch type, such as TEA 6415B or like) which is schematically shown as a two-output (1,2) switch CV and namely it is applied to its "common" pole.

Before entering into matrix circuit M1, signal [V1 + V2] is also connected to a sync separator circuit SS2 and to a memory bank MEM. In this latter circumstance, it is to be remarked that, since signal [V1 + V2] is an analogue signal, as the whole circuit is of analogue type, while memory MEM is digital, it is necessary to insert upstream and downstream of memory MEM an analogue/digital converter A/D and a digital / analogue converter D / A , respectively.

The above quoted sync separator unit SS2, in turn, separates the vertical sync signal and applies it to a microprocessor MP which also receives a high frequency clock signal from an oscillator unit OS (of 25 MHz) and drives a "control logic" circuit LP. The control logic circuit LP receives a high frequency clock signal of 25 MHz from the already quoted oscillator circuit OS and drives the memory block MEM.

Furthermore, microprocessor MP also drives a second stage M2 of the same matrix circuit (in Figure 11, in order to avoid drawing complications, the two stages M1 and M2 of the matrix circuit have been shown as two separate blocks indicated by dashed lines, but it should be understood that, as a matter of fact, they are comprised in a single

integrated circuit). It can be noted that the output signal of memory unit MEM is applied to a common pole of said second stage M2 of the matrix circuit, this second stage M2 having also been schematically drawn as a two-output (1,2) switch CM.

From a structural view point, it can be observed that two adder circuits S1 and S2 are also provided: the first adder circuit S1 is designed to add the output signals from the output pole 1 of the first stage M1 and from output pole 2 of the second stage M2 and, respectively, the second adder circuit S2 is designed to add the output signals from the output pole 2 of the first stage M1 and from the output pole 1 of the second stage M2 of said Matrix Switch circuit.

Downstream of said adder circuits S1 and S2, two respective final amplifier circuits AMP1 and AMP2 are provided.

The operation of the above described decomposer or de-interlacer device is as follows.

Microprocessor MP, based upon the information it receives from sync separator block SS2, drives the switch matrix blocks M1-M2 in order that the two switches CV and CM included therein carry out in perfect synchronism with each other and with the vertical frame synchronisation pulses of composite signal [V1 + V2] a commutation at 20 millisecond intervals (corresponding to 1/50 second: the time duration of a field).

It should be remarked at this point that, as it is well known to those skilled in the art, signal [V1+ V2] has the characteristics of a conventional video signal, which means that, for instance when PAL system is adopted, each frame of 625 rows is formed by a field of 312,5 odd rows extracted from the first component signal V1 and by a field of 312.5 even rows extracted from the second component signal V2. The two fields alternate at 1/50 second intervals.

Since the switching 1-2 controlled by said microprocessor MP occurs at 1/50 second intervals, switch CV will be in position 1 for a 1/50 second time duration and will let only the odd field V1D of signal V1 pass and it will be switched over to position 2 after a 1/50 second time and will then let only the even field V2P of signal V2 pass. Then the cycle repeats and in position 1 a further odd field of signal V1 and in position 2 a further even field of signal V2 will pass, and so on. In position 1, of course, only the odd fields of signal V1 and in position 2 only the even field of signal

V2 are enabled to pass. In other words, from pole 1 of switch CV a signal V1D is issued comprising only odd fields of signal V1 and from pole 2 a signal V2P is issued comprising only even fields of signal V2.

These two signals V1D and V2P, however, are anomalous in that in each frame they include one only field: the second field for forming a complete frame is lacking. As it will be explained herein below, this lack is fulfilled by memory MEM.

The above mentioned memory MEM is of FIFO type and, therefore, it continuously stores or loads data and, when it is filled, it issues or unloads the previously stored data, while it continues to store newly arriving data.

The memory assembly A/D - MEM- D/A (the memory with analogue/digital and digital/analogue converters associated thereto) is connected at its first end (leading or input end) to signal [V1+V2] and at its other end (unloading or output end) to the second stage M2 of the matrix switch circuit, namely to the common pole of the schematically shown switch CM, that, as above explained, is switched to its positions 1 and 2 at 1/50 second intervals, in perfect synchronism with switch CV, under control of microprocessor MP.

When switches CV and CM are in position 1, switch CV lets the odd field V1D of signal V1 pass and memory MEM in the same stores the same odd field V1D. When, after a 1/50 second time, switches CV and CM are turned to position 2, switch CV lets the even field V2P of signal V2 pass and memory MEM stores the same even field V2P and outputs the previously stored odd field V1D of signal V1 into the first adder circuit S1 (to which also the signal containing the odd fields V1D of signal V1 is applied) thereby filling up exactly the signal lack which occurs because switch CV is in position 2, as well. In other words, this stored field V1D exactly takes the place of the lacking field. The first video signal V1 is therefore re-established: each frame thereof will be comprised by an odd field - namely the starting one - and by a "dummy" field - namely the stored one, which in effect is the same starting previous field.

Memory MEM while is outputting the field V1D of signal V1 in the same time is storing the field V2P of signal V2 and it will output it into the second adder circuit S2 when switch CM is switched over to position 1, and so on.

By comparison to Figure 3, it can be observed that the assembly A/D - MEM - D/A carries out the same function of duplicator assembly 114.

The devices of Figures 8 and 9 have been shown as independent separate devices, but it should be understood that this should in no way be construed in restrictive sense, in fact both devices can be built in directly in newly manufactured video recorders, or be manufactured separately or in combination for association with existing video recorders.

In the previous description the preferred embodiment has been described and variation thereof have been suggested, but it should be understood that those skilled in the art can make further changes and alterations to the various components without departing from the scope of this invention as defined in the attached claims.

CLAIMS

1. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs, characterised in that, in a transmission/recording operation, the two video signals (V1, V2) of the two different programs are composed by means of a composer device (8; SW)into a single composite video resultant signal ([V1 + V2]) which includes a field (odd or even rows) of the first signal (V1) and a field (even or odd rows) of the second signal (V2) and, in a reception/reproduction operation, each frame of said video resultant signal ([V1 + V2]) is decomposed by means of a decomposer device (108; M1, M2) into its component fields (odd and even rows), respectively pertaining the one to said first video signal (V1) and the second to said second video signal (V2), said signals being adapted to be separately utilised after having been passed through a duplicator device (114; A/D-MEM-D/A) which adds to each field obtained by means of said decomposition step an identical field obtained by duplication thereof, in order to re-establish a whole frame.

2. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claim 1, characterised in that also the two audio signals (A1, A2) associated to said two video component signals (V1, V2) composed to obtain said resultant video signal ([V1 + V2]) are transmitted/recorded contemporaneously with said resultant video signal ([V1 + V2]).

3. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claims 1 and 2, characterised in that said composer device (8; SW) comprises a matrix circuit of the Matrix Switch type, to the two inputs of which said component video signals (V1, V2) to be composed are applied, said matrix circuit being driven by a sync separator circuit (SS1) which receives as input signal one of said two component video signals (V1, V2), said matrix circuit operating in such a way as to extract a field (even or odd rows) of the first component video signal (V1) and a field (odd or even rows) of the second video component signal (V2) and to supply an output signal comprised of the sum of said extracted fields, the said device further

comprising an amplification stage (SA) to amplify the resultant video signal ([V1 + V2]) and a three-way switch (C) to select the one or the other of said video signals (V1, V2) or said composite video resultant signal ([V1 + V2]).

4. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claims 1 and 2, characterised in that said decomposer device comprises a first stage (M1) of a matrix circuit of the Matrix Switch type, which carries out the decomposition of each frame of said composite video resultant signal ([V1 + V2]) into its two component fields and applies said component fields to the first inputs of two respective two-input adder circuits (S1, S2), a sync separator circuit (SS2) which receives said composite resultant signal ([V1 + V2]), extracts the sync signal therefrom and drives a microprocessor (MP) by which said first stage (M1) of said matrix circuit is controlled.

5. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claims 1, 2 and 4, characterised in that said duplicator device (114) receives said composite resultant video signal ([V1 + V2]) and comprises a memory chain including an analogue/digital converter (A/D), a digital memory (MEM) of FIFO type and a digital/analogue converter (D/A), a control logic circuit (LP) driven by said microprocessor (MP) to control said memory (MEM), the output of said memory chain (A/D-MEM-D/A)being connected to a second stage (M2) of said matrix circuit, which is also controlled by said microprocessor (MP) and has its outputs connected to the second inputs of said two-input adder circuits (S1, S2).

6. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claim 5, characterised in that the outputs of said adder circuits (S1, S2) are connected to two amplifier circuits (AMP1, AMP2).

7. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claims 1 and 2,

characterised in that a balancing potentiometer(B) is provided between the inputs of said matrix circuit (SW) of said composer device (8).

8. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claims 1 and 2, characterised in that in the output section of said composer device (8;SW) a three-way switch (C) is provided to enable the selection between the two component video signals available at the input of the circuit and the composite resultant video signal ([V1 + V2]) obtained by composition thereof.

9. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claim 8, characterised in that said three-way switch (C) is automatic in order that, when one of said component video signals (V1, V2) is lacking, it automatically allows the other one to pass.

10. A system for composition/decomposition of video signals for transmitting/receiving and for recording/reproducing with alternance of fields two different television programs according to claims 1, 2 and 4, characterised in that said duplicator device is a delay line having a delay corresponding to one row of a field in order to duplicate each row of each field.

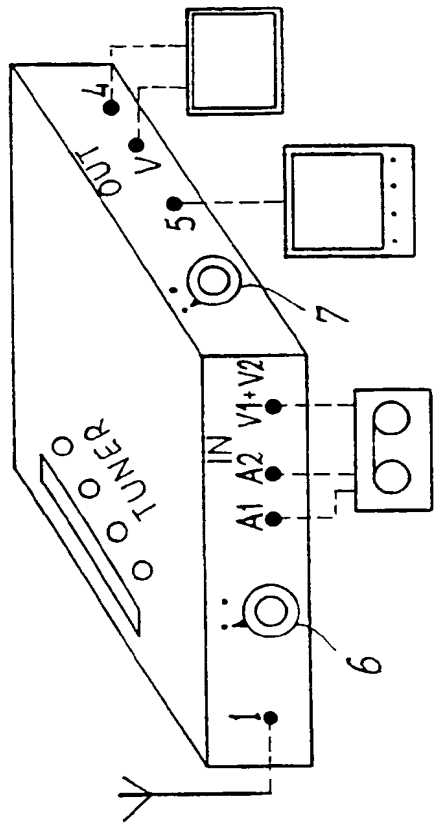


FIG. 2

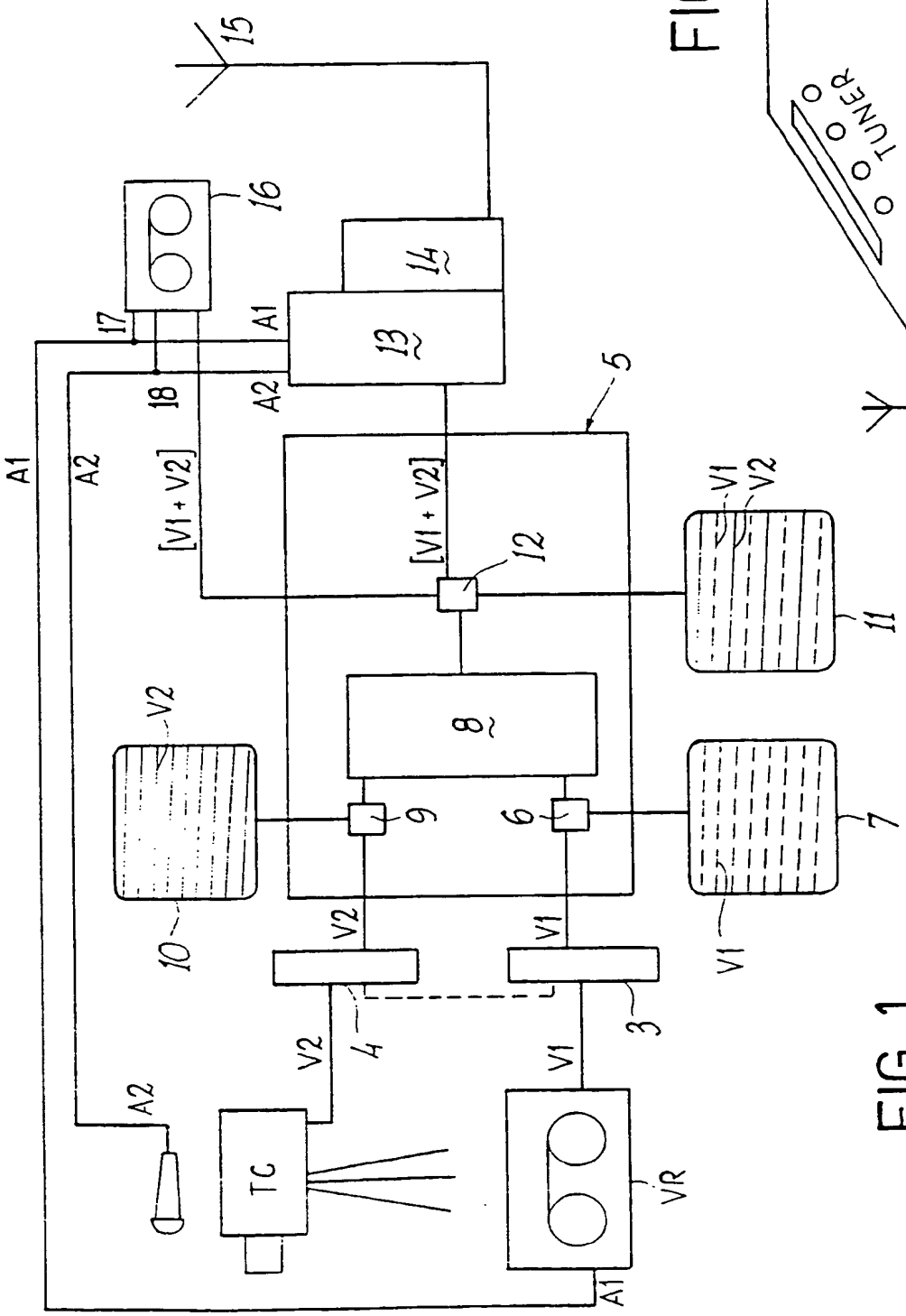


FIG. 1

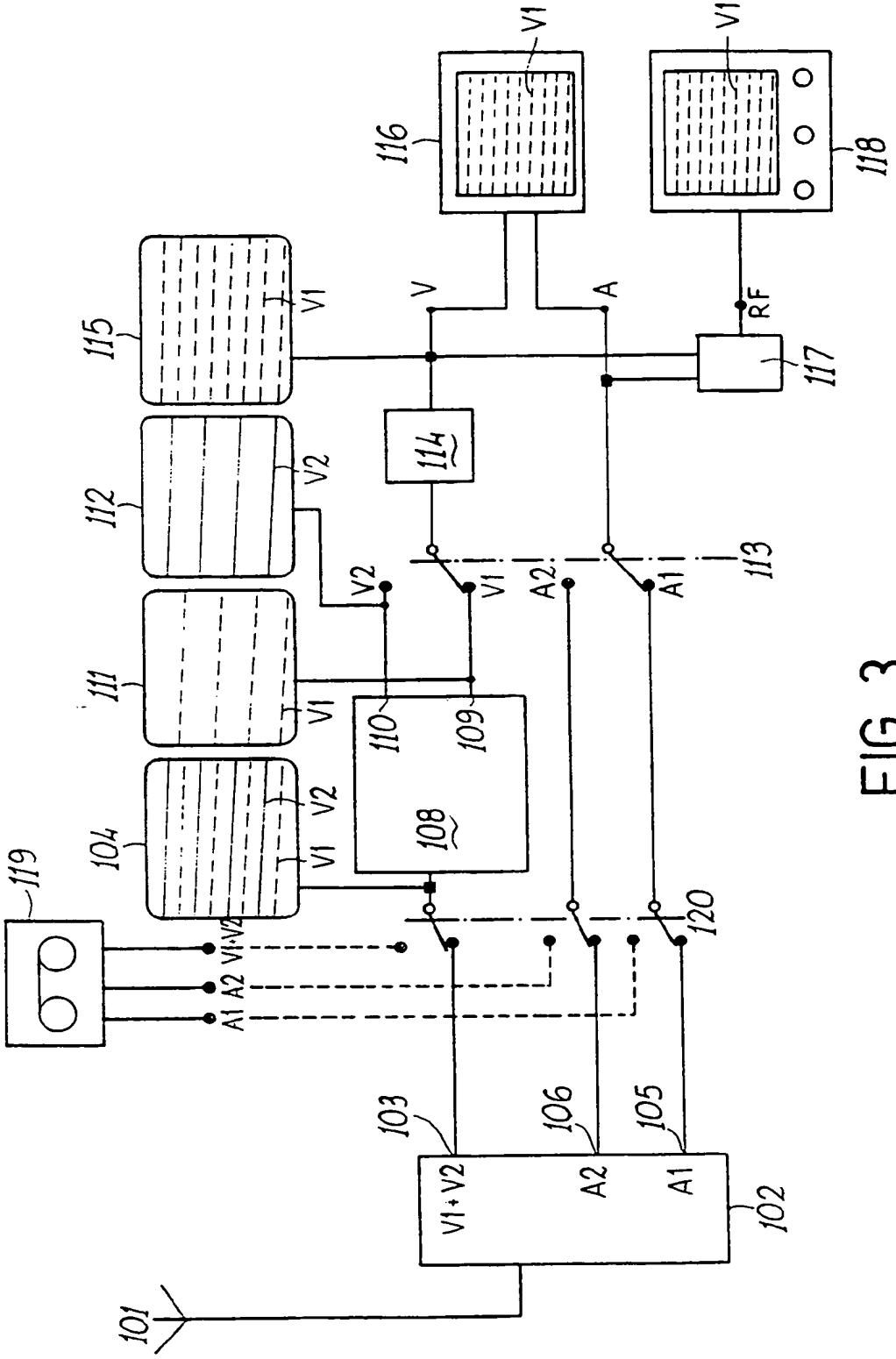


FIG. 3

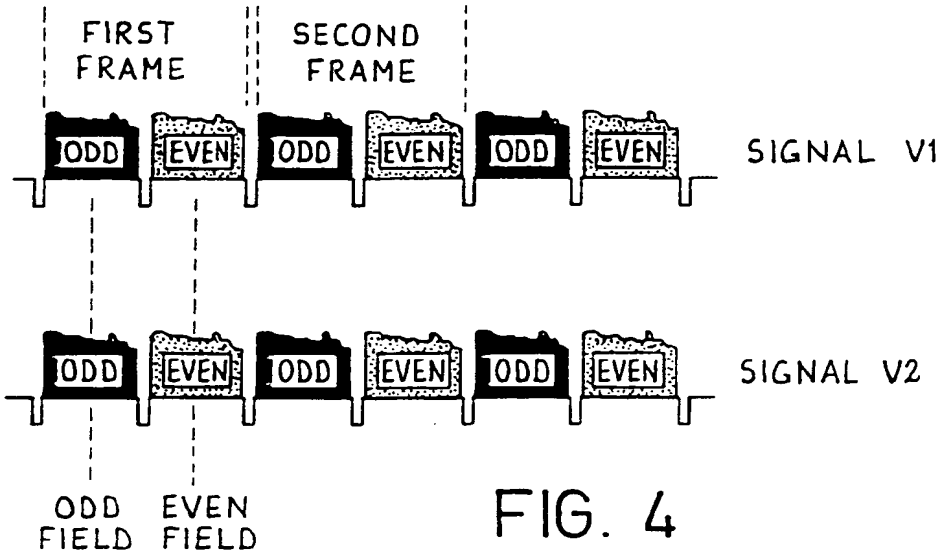


FIG. 4

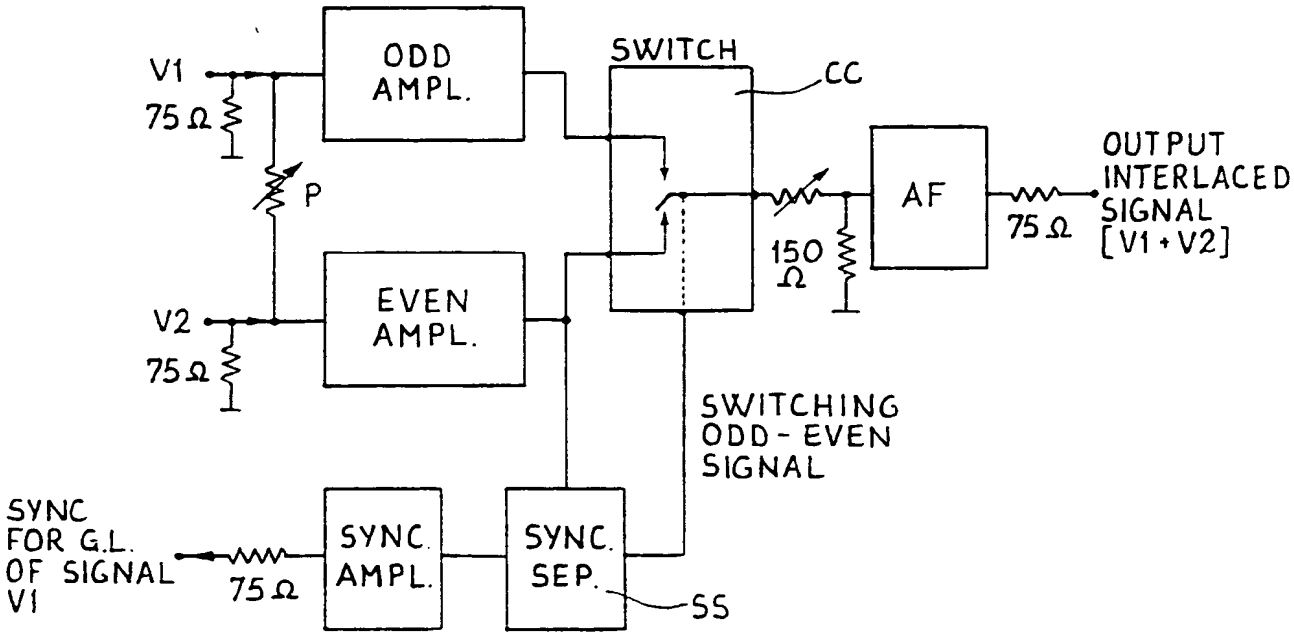


FIG. 5

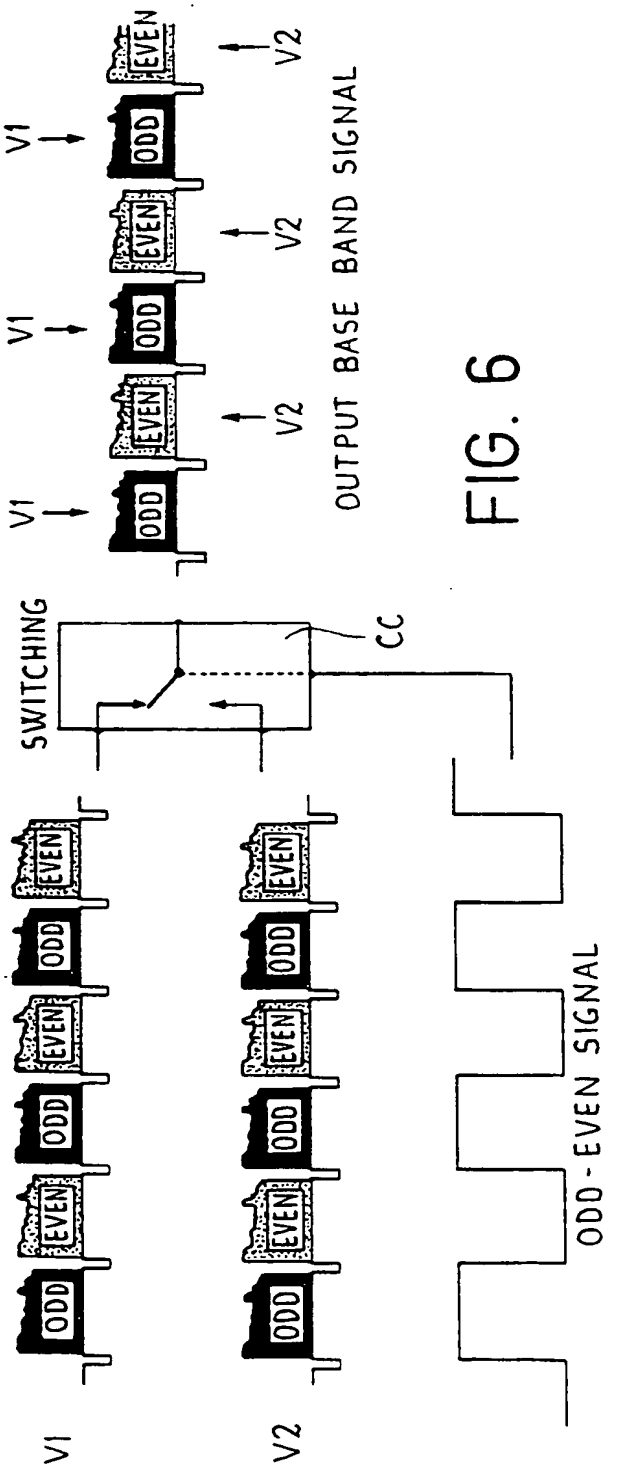


FIG. 6

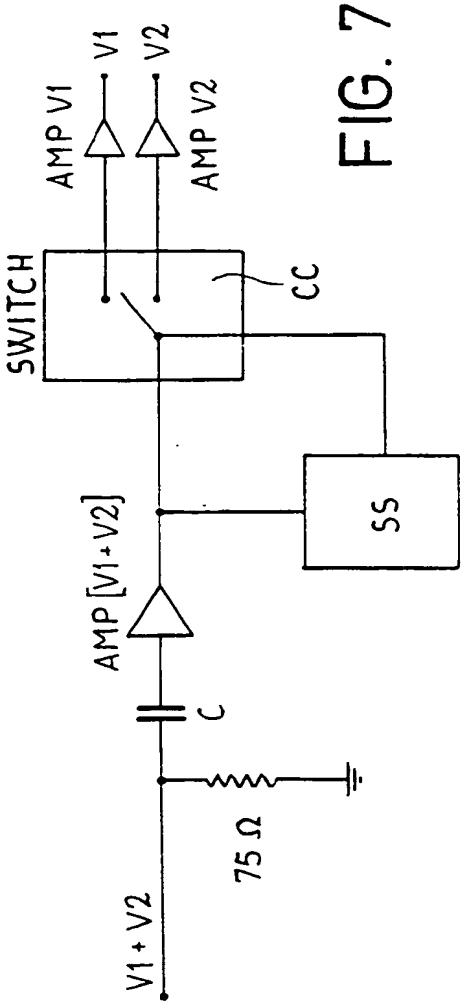


FIG. 7

FIG. 8

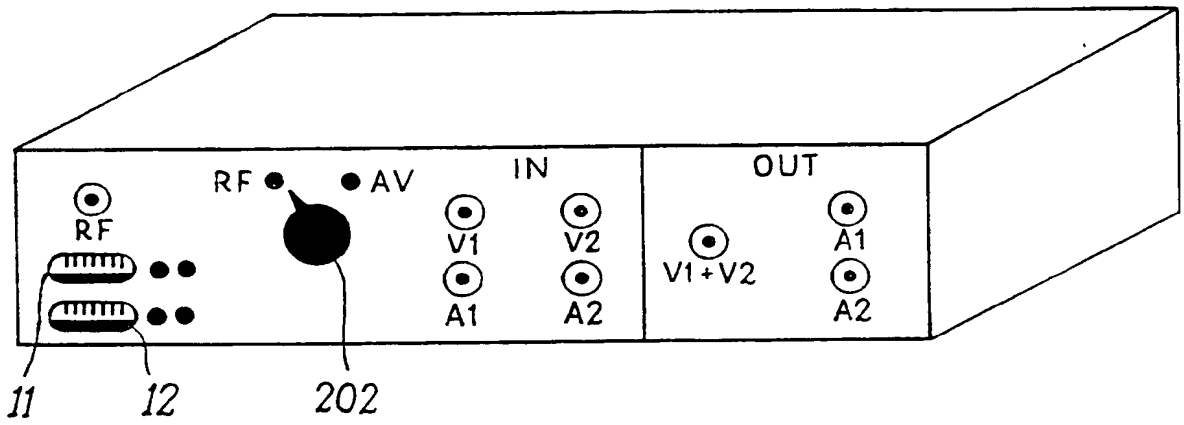
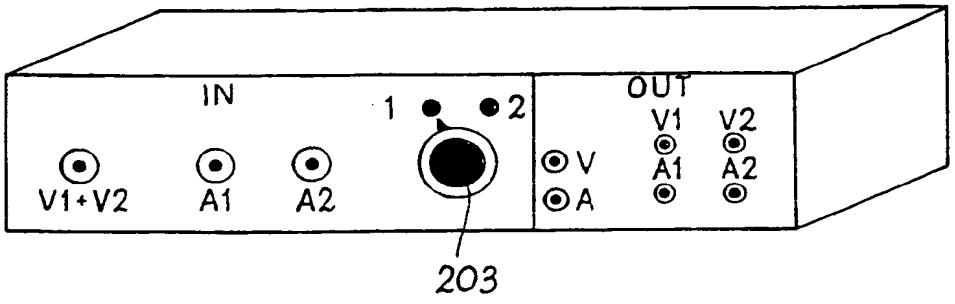


FIG. 9



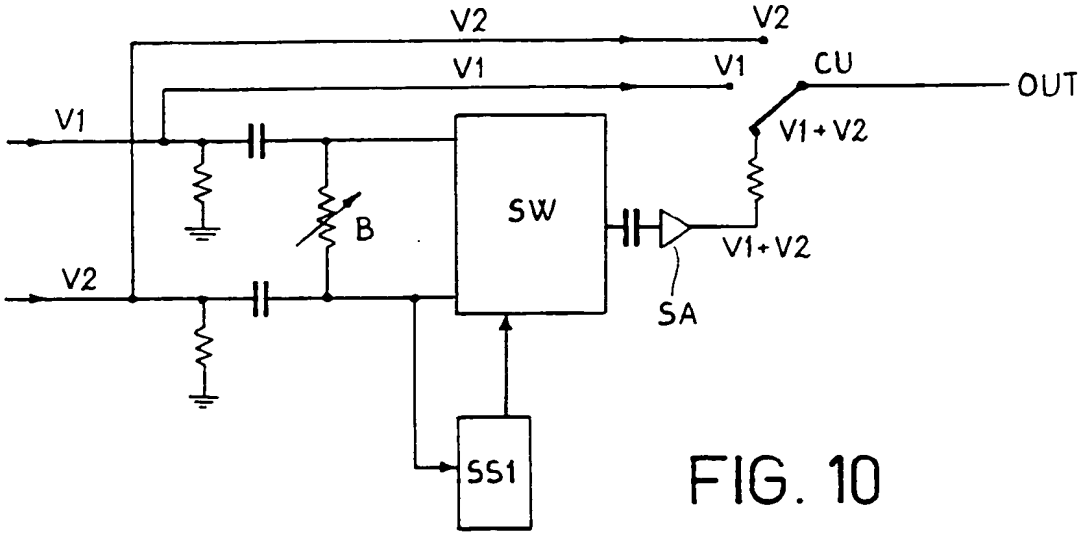
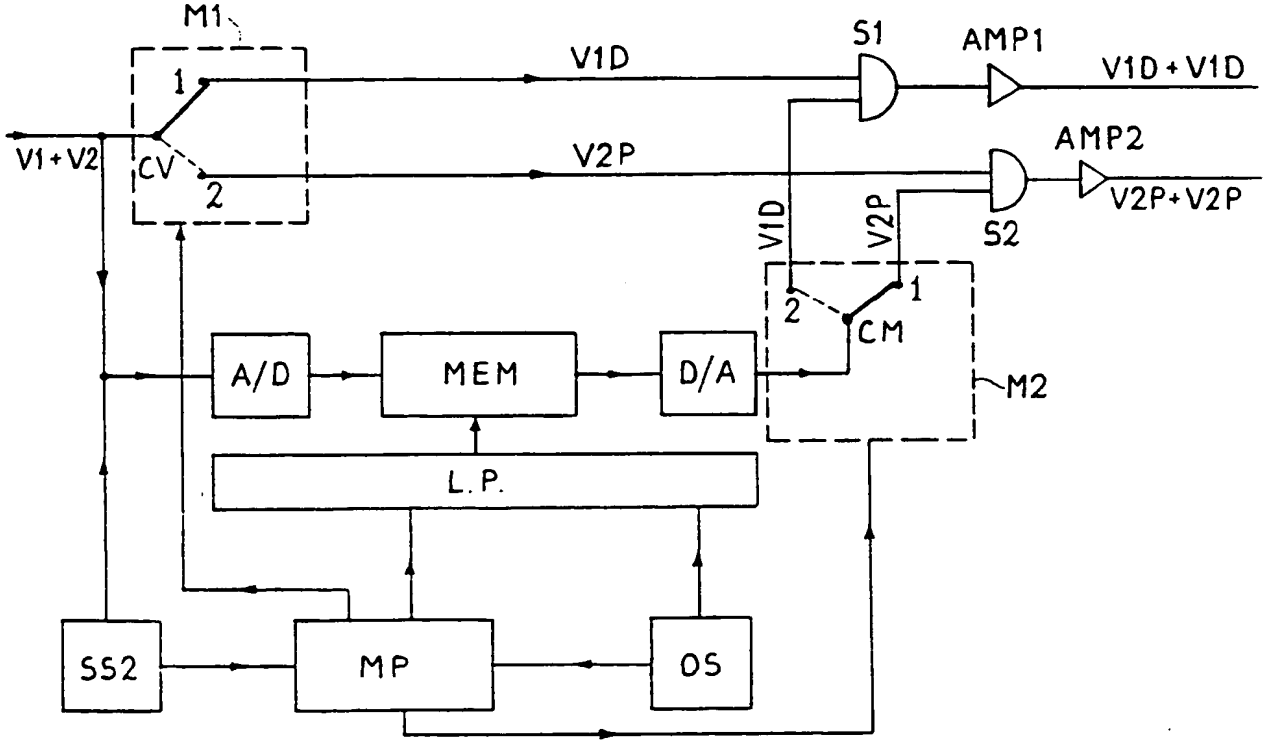


FIG. 10

FIG. 11



INTERNATIONAL SEARCH REPORT

Intern. nal Application No
PCT/IT 94/00002

A. CLASSIFICATION OF SUBJECT MATTER
IPC 5 H04N7/08 H04N5/92

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 5 H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP,A,0 423 652 (VARIOVISION KOMMUNIKATIONS-SYSTEME) 24 April 1991 see the whole document	1,2
Y		8
A		3-5

X	DE,A,41 29 127 (SAMSUNG ELECTRONICS) 26 March 1992 see the whole document	1
Y		8
A		3-5

X	EP,A,0 253 121 (ROBERT BOSCH GMBH) 20 January 1988 see column 8, line 13 - column 11, line 7 see column 11, line 45 - column 12, line 32; figures 1-3	1
A		3-5

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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1

Date of the actual completion of the international search	Date of mailing of the international search report
1 June 1994	3. 06. 94

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Verleye, J

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INTERNATIONAL SEARCH REPORT

Inter nal Application No
PCT/IT 94/00002

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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A	US,A,3 857 999 (JUSTICE) 31 December 1974 see column 3, line 9 - column 6, line 51; figures 1-3	1,3,4,8, 10
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INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter nal Application No
PCT/IT 94/00002

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		JP-C-	1365761	26-02-87
		JP-A-	52082015	08-07-77
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US-A-3837003	17-09-74	NONE		
GB-A-2148069	22-05-85	NONE		
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